ACCESSIBLE CAVES IN SLOVAKIA AS A TOOL FOR GEOSCIENCE EDUCATION

Miriama Javorská, Silvia Palgutová, Kristína Pramuková
Department of Geo and Mining Tourism, Institute of Earth Resources, Faculty of Mining, Ecology, Process Control and Geotechnology, Technical University of Košice, Boženy Němcovej 32, SK-042 00 Košice, Slovakia

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Abstract
Slovakia is a country which is rich in karst area. There are more than 8 100 caves in Slovakia. Caves represent a unique and valuable environment for Earth science education. Their study enables a better understanding of geological processes, hydrological cycles, climate changes, as well as the history of life on Earth. With their remarkable features, they appeal not only to experts of various fields, but also to the general public. Several caves are accessible to the public, which offer a unique experience of discovering the underground world, as well as various educational activities. The aim of the article is to characterize the accessible caves in Slovakia and to point out their current state, protection, use and forms of presentation.

Key words: karst area, natural heritage, geoeducation

Introduction

The accessible caves represent a unique tool of geoscience education, which allows the public to learn about geological processes and phenomena, climate changes or the history of life on our planet. Geoeducation can be characterized as a type of informal education, which includes imparting knowledge in the field of Earth sciences, as well as raising awareness about geological heritage and its connections with other aspects of natural or cultural heritage, and supports the recipient's need to protect it for future generations We can also talk about geoscience education as a broader understanding of environmental education, the aim of which is the promotion and protection of the geological heritage of a given place (Miśkiewicz et al., 2024). The Ministry of the Environment of the Slovak Republic (SR) is a key body of state administration of the SR, which focuses on the creation and protection of the environment. As part of its activities, it supports environmental education and training, develops promotional, editorial and documentation activities, at the same time, it creates a space for the development of environmental awareness of the public through the activities of professional organizations (Slovak Caves Administration, Slovak Museum of Nature Protection and Speleology). The Slovak Caves Administration (SSJ) carries out educational activities focused on the protection of caves, provides publishing, editorial-promotional and publishing activities focused on the protection, research, and use of caves (SSJ, 2013i). The Slovak Museum of Nature Protection and Speleology (SMOPaJ) raises environmental awareness among the general public through educational, lecture, publication and exhibition activities. The aim of the article is to briefly characterize accessible caves in Slovakia as a tool for geoscience education and point out their current state, protection, use and presentation in the form of educational trails with information boards or expositions and exhibitions.

Material and methods

From a methodological perspective, we conducted an excerpt and analysis of literature dealing with the issue of geoscience education and accessible caves in Slovakia. Based on an excerpt and analysis of the literature, we have developed a brief description of the individual accessible caves, which includes their current state, protection, use, and various forms of presentation. This description was prepared based on information, which is available on the SSJ web portal.

Results and discussion

The SSJ ensures the protection and operation of 13 caves in Slovakia – Belianska Cave, Brestovská Cave, Bystrianska Cave, Demänovská Cave of Liberty, Demänovská Ice Cave, Dobšinská Ice Cave, Domica Cave, Driny Cave, Gombasecká Cave, Harmanecká Cave, Jasovská Cave, Ochtinská Aragonite Cave and Važecká Cave. The aforementioned accessible

caves are declared a natural heritage of the Slovak Republic. The Ochtinská aragonite cave, the Domica cave, the Gombasecká cave and the Jasovská cave since 1995, and the Dobšinská ice cave since 2000 are inscribed on the World Natural Heritage List of the United Nations Educational, Scientific and Cultural Organization (UNESCO). These caves have an invaluable and irreplaceable value of global significance, which is why they require special protection, care, and presentation (SSJ, 2013p). Despite their strict protection, some accessible caves are used for speleotherapy. Such caves include Belianska Cave, Bystrianska Cave, Jasovská Cave, Domica Cave, in the past also Gombasecká Cave.

Belianska Cave, the most visited accessible cave in Slovakia, is located in the Belianske Tatras Mts. From the parking lot to the entrance to the cave, there is an educational trail with a length of 890 m, which contains 6 panels – basic information and the protection of the Tatra nature; geological and geomorphological settings of the Belianske Tatras; forest societies; plants; animals and Belianska Cave (SSJ, 2013a). The tour route in the cave is 1 370 m long and lasts 70 minutes. During a tour of the cave, visitors can admire sinter waterfalls, pagoda stalagmites, lakes, and other forms of cave decoration. One of the stops on the tour route is in the Musical Hall, where classical music concerts are organized (SSJ, 2013n).

The Brestovská Cave located in the Western Tatras Mts. is characterized by a remarkable morphology of the spaces, rare cave fauna, as well as a riverbed with an active water flow with 7 siphons, which represents an extensive underground hydrological system. The length of the cave tour is 1 370 m and lasts 50 minutes (SSJ, 2013b).

Bystrianska Cave is considered the most important cave located in the Upper Hron River Valley. The cave is interesting for its remarkable rock formations, evolution of underground spaces, the occurrence of sinter filling, as well as its historical significance. The cave tour is 580 m long and lasts 45 minutes (SSJ, 2013c).

On the northern side of the Low Tatras Mts. is the Demänovská Cave of Liberty, which is morphologically the most diverse part of the Demänovská cave system with a rich sinter filling of various colors. The cave tour consists of 2 circuits. The route of the traditional circuit is 1 150 m long and lasts 60 minutes. The long circuit is 2 150 m long and the tour lasts 100 minutes (SSJ, 2013d). A serpentine path with information panels leads to the entrance to the cave. The educational trail contains 6 panels – introduction, sketch of the trail; basic karst phenomena of the territory and karst hydrology; karst and cave of Slovakia; accessible caves of Slovakia; Demänovská Cave of Liberty; discovery and development of the Demänovská Cave of Liberty for public. The length of the trail is about 400 m (SSJ, 2013n).

Part of the Demänovská cave system is also the Demänovská Ice Cave, which was characterized by the occurrence of permanent ice filling. Currently, due to the warm winter season, the cave has lost the last remnants of ice. In addition to its ice filling, it is known for its massive underground spaces, cave fauna, and rich history. The cave tour route is 650 m long and lasts 45 minutes (SSJ, 2013e). There is a 450 m long educational trail with 6 educational panels leading to the cave – basic information and situation map; National Nature Reserve (NPR) Demänovská Valley and forest societies; animals; plants; Demänová cave system and Demänovská Ice Cave (SSJ, 2013n).

The Dobšinská Ice Cave is located in the Spiš-Gemer Karst, which is considered one of the most important ice caves in the world and visitors can admire its various ice formations. The cave tour route is 515 m long and lasts 30 minutes [7]. An educational trail was built to the cave, which is 470 m long and contains 5 panels – basic information and protection of the National Park (NP) Slovak Paradise; NP Slovak Paradise, ravines, forests; NPR Stratená, natural values; flora, fauna and forest societies; Dobšinská Ice Cave (SSJ, 2013). There is an exhibition in the entrance area of the cave, which consists of 6 panels. The first part presents karst phenomena of the Slovak Paradise, cave system of the Stratenská Cave, glaciation of the Dobšinská Ice Cave and geomorfological things of interest of the Slovak Paradise. The second part introduces the history of the Dobšinská Ice Cave, its discovery, development for tourists and scientific research of ice filling (SSJ, 2013n).

Domica Cave is located on the Silická Plateau in the Slovak Karst. This is the most famous and longest cave in the Slovak Karst, which at the same time attracts attention with its significant geomorphological values, archaeological findings, but also cave fauna. The cave tour consists of 2 circuits. The short circuit is 780 m long and lasts 45 minutes. The long circuit with a cruise on the underground river Styx is 930 m long and lasts 60 minutes (SSJ, 2013g). An exhibition of archaeological findings and sinter decoration was originally installed in the entrance area of the

cave, which was later expanded to include illustrative displays of scarp, sinkholes, caves, archaeological objects and a historical exhibition. Also 8 panels were added – basic types of karren, dolines, caves, rock shapes in caves, sintered filling, cave animals, archaeological objects in Domica and the role of water in karst. Part of the area is also a room with a large-screen screening of educational films (SSJ, 2013j).
The only accessible cave in the western Slovakia, located of the Lesser Carpathians, is the Driny Cave. The cave is system of narrow fissure passages with rich dripstone decoration. The cave tour is 450 m long and lasts 30 minutes (SSJ, 2013h).
Gombasecká Cave is located on the Silická Plateau in the Slovak Karst. The cave is characterized by the occurrence of thin straw stalactites, which can reach as much as 3 m length. The length of the tour is 530 m and it lasts 30 minutes (SSJ, 2013k).
Harmanecká Cave in the Great Fatra Mts. is known for the remarkable formation of underground spaces, abundant occurrence of soft sinter, as well as cave fauna. The cave tour is 1 020 m long and lasts 60 minutes (SSJ, 2013l). An educational trail was built to the cave, which is 1 300 m long and contains 9 panels – introduction; geological settings of the Harmanecký karst; forest and plant societies; invertebrates of cave surrounding; vertebrates; yew in Harmanec surrounding; Harmanecká Cave; animals of the Harmanecká Cave and the history of the cave (SSJ, 2013n).
Jasovská Cave is located on the Jasovská Plateau in the Slovak Karst, whose dominant feature is the abundant occurrence of calcite sinter filling, remarkable rock formations, the development of underground spaces, as well as archaeological findings and an interesting history. The tour route in the cave is 720 m long and lasts 45 minutes (SSJ, 2013m). The exhibition in the entrance area of the cave consists of 2 parts – the first part contains information about the geological and geomorphological settings of the Jasovská Cave and its surroundings, about the forms of sinter filling, speleoclimatic and hydrological settings of the cave, paleontological findings and cave fauna. The second part of the exhibition presents the protection of the cave within the NPR Jasovské dubiny in the NP Slovak Karst and speleoclimatic treatment in the cave (SSJ, 2013j).
The Ochtinská aragonite cave in the Slovak Ore Mts. is considered a unique natural phenomenon, which is characterized by its rich and diverse aragonite decoration, as well as the peculiar formation and development of underground spaces. The length of the tour is 300 m and its duration is 30 minutes (SSJ, 2013o).
Važecká cave is located on the border of the Kozie chrbty Mts. and the Liptovská Basin. The cave is characterized by the occurrence of rich dripstone decoration, remarkable findings of cave bear bones, as well as by rare cave fauna. The cave tour is 235 m long and lasts 25 minutes (SSJ, 2013r). The permanent zoopaleontological exposition is part of the cave tour. It is focused on the popular educational presentation and promotion of the cave bear. New elements of the exhibition include a reconstruction of a skeleton and a sculpture of a cave bear, which was added to the original exhibition of bones, teeth, claws and skulls. In the outer area of the cave, 2 panels have been added, focusing on general information on body size and weight, origin and distribution, biotope, reproduction, age, food and causes of extinction of the species, as well as specific data regarding local findings from the Važecka Cave (SSJ, 2013j).

Conclusion

Slovakia is one of the countries that can boast a rich abundance of caves. Accessible caves in Slovakia as educational sites have an important role in geoscience education. Permanent exhibitions are located in the Dobšinská Ice Cave, Domica Cave, Jasovská Cave and Važecká Cave. Educational tourist trails have been created to the Belianska Cave, Demänovská Cave of Liberty, Demänovská Ice Cave, Dobšinska Ice Cave and Harmanecká Cave, which contain educational panels with various themes. From the point of view of geoeducation, the Demänovská Cave of Liberty, Domica, Dobšinská Ice Cave, and Harmanecká Cave have the greatest potential, due to their genesis, diversity, and also scientific significance.

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Souhrn
Slovensko je země, která je bohatá na krasové území. Na jeho území je více než 8 100 jeskyní. Jeskyně představují jedinečné a cenné prostředí pro vzdělávání v oblasti věd o Zemi. Cílem příspěvku je stručně charakterizovat zpřístupněné jeskyně na Slovensku jako nástroj geovědného vzdělávání a poukázat na jejich současný stav, ochranu, využití a prezentaci v podobě naučných stezek s informačními tabulemi nebo expozic a výstav, které zastřešuje, které zastřešuje Správa slovenských jeskyní (SSJ) a Slovenské muzeum ochrany přírody a jeskyňářství (SMOPaJ).

Contact:
Mgr. Miriama Javorská
miriama.javorska@tuke.sk

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